

MONTHLY WEATHER REVIEW.

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No. 1

The MONTHLY WEATHER REVIEW is based on data from about 3500 land stations and many ocean reports from vessels taking the international simultaneous observation at Greenwich noon.

Special acknowledgment is made of the data furnished by the kindness of cooperative observers, and by Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; H. H. Cousins, Chemist, in

charge of the Jamaica Weather Office; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen College, Havana, Cuba.

As far as practicable the time of the seventy-fifth meridian, which is exactly five hours behind Greenwich time, is used in the text of the MONTHLY WEATHER REVIEW.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e. apparent gravity at sea-level and latitude 45°.

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

THE CYCLONIC STORM OF OCTOBER 6-12, 1905, IN THE NORTH ATLANTIC OCEAN.

By Mr. JAMES PAGE, Chief, Division of Ocean Meteorology. Dated February 15, 1906.

Throughout the interval covered by October 6-12, 1905, the western half of the North Atlantic Ocean was the scene of a cyclonic storm of great violence, which during the period mentioned made its way from the Caribbean Sea to the vicinity of Newfoundland. At the center of the barometric depression accompanying this storm the atmospheric pressure diminished to 27.90 inches (709 mm.). Throughout the latter part of its course the area over which winds of hurricane force prevailed attained a diameter of 600 miles, or more, and the attendant seas were so high as to seriously retard and in some cases damage even the staunchest of such of the transatlantic liners as came within the area of maximum severity, while vessels of ordinary power were obliged to heave to and remain practically unmanageable until the storm subsided.

As is usual at this season of the year, the storm was of tropical origin, the first intimation of its existence being contained in the weather report returned to the U. S. Weather Bureau by Capt. Egidio Gibelli, master of the Italian bark *Primo*, bound from Antwerp to Pensacola. The position of the bark at Greenwich mean noon (local mean time 7:35 a. m.) of October 6 was latitude 15° 2' north, longitude 65° 58' west, 200 miles to the southward of Porto Rico, and the master's report for the preceding 24 hours reads as follows:

Light winds from ESE., increasing in force; between 11 a. m. and 12 noon (of October 5) the barometer fell rapidly from 29.96 to 29.90 inches, the sky at times covered by dense masses of clouds. As a precaution I hove to, with head to sea, for observation, content to sacrifice time in order to ensure safety. At 3 p. m. the barometer stood at 29.88 inches, and a dense nimbus cloud covered the northwestern sky. In about an hour the clouds commenced to break, the barometer ceased to fall, and the weather began to assume its normal aspect; proceeded on course.

The storm was felt throughout the island of Haiti on the following day. The weather report returned by Professor Scherer, Director of the Meteorological Observatory at Port au Prince, states that the sky was continuously overcast from October 1-6; at St. Nicolas Mole a furious gale from the SW. prevailed during the night of October 5-6, accompanied by exceptionally high tide and heavy seas. The gale continued without interruption throughout October 6. Three sailing vessels were driven ashore and the neighboring plantations

were damaged by inundations. The total rainfall was 3.8 inches. Throughout the interior of the island the rivers overflowed their banks, inflicting great damage upon the coffee, cane, and banana crops; trees were uprooted, and houses destroyed. The inundations were especially severe in those streams rising near the Morne de Selle and on its northern slope. In Port au Prince the barometer fell to 29.72 inches.

Upon emerging from the Caribbean Sea into the Atlantic the area of low barometer and strong winds retained the small diameter which characterizes these storms as long as confined to tropical latitudes. During October 7 and 8 a number of vessels en route to and from West Indian waters must have been within easy distance of the center of the hurricane, but none report more than lowering, squally weather with barometer slightly below the average. Thus, the French cruiser *Troude*, Captain Mottez in command, left Bermuda October 5, bound for Martinique; followed a southerly course along the meridian of 64° west, passing Sombbrero at midnight October 9-10. Her barometer gave no evidence of the existence of a depression in the vicinity. At 4 p. m. of October 7, position 26° north, 64° west, the wind suddenly freshened from the south, showing that the vessel had penetrated the outskirts of the cyclonic circulation, its force, however, at no time exceeding 5 on the Beaufort scale. To the westward of the line of progress, throughout October 7 and 8, the presence of the depression gave rise to a steepening of the barometric gradients extending as far as the American coast, with the result that throughout this whole region as far north as Hatteras northeasterly gales of force 8 prevailed, as shown by the reports of the *Alene* (Ger. S. S.), *Wolpert*; the *Caracas* (Am. S. S.), *Goodrich*; the *Nordfarer* (Dan. S. S.), *Brunich*, and numerous other vessels.

The weather conditions existing over the western half of the ocean at the instant of Greenwich mean noon of October 9 are shown by the accompanying synoptic weather chart, fig. 1. Upon this date the full violence of the storm was encountered by the *France Marie* (34¹), bound from Gibraltar to the Capes of the Delaware by way of the trades. The characteristic features by means of which the trained observer is accustomed

¹ Number 34 in the accompanying list and on the synoptic charts. In these charts the arrows fly with the wind, the center of the arrowhead marking the position of the vessel. The number of feathers gives the force of the wind on the Beaufort scale; the shading of the head shows the proportion of clouded sky.

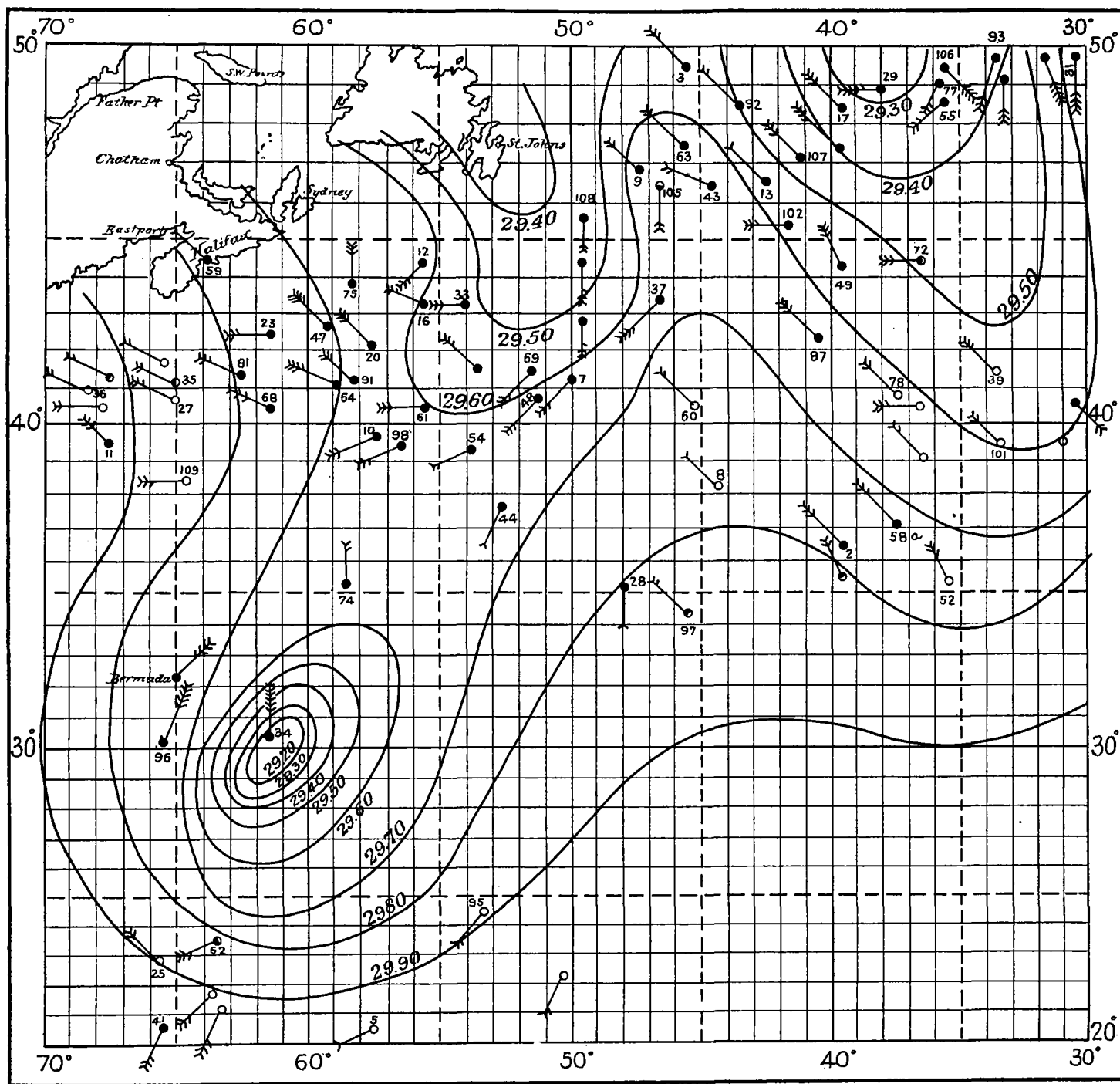


FIG. 1.—Synoptic weather chart, Greenwich mean noon, October 9, 1905.

to recognize the proximity of a severe cyclonic storm are all present in the report furnished by Captain La Croix. At Greenwich mean noon of October 8 the bark was in latitude 31° north, longitude 59° west, probably 500 miles to the ENE. of the position of the storm center at that time. The barometer stood at 30.08 inches (764 mm.), with an easterly wind of force 3; sky overcast, with fine rain and a heavy swell from the westward. Throughout the evening the wind increased to a strong breeze, but fell off somewhat during the night, with heavy rain. At daybreak of October 9 the glass had fallen to 29.88 inches (759 mm.), this preliminary gradual descent marking the entrance of the vessel into the outer circle of the storm. The radius of the hurricane proper was attained at 7:30 a. m. At this hour the wind freshened rapidly, shifting first to NE. and later to N., the barometer in the space of the next two

hours falling to 29.16 inches (741 mm.). These two facts taken in conjunction would ordinarily be regarded as justifying the conclusion that the position occupied was in the forward quadrant of the storm, and that the center was rapidly bearing down upon the observer. Unless prevented by exceptional circumstances from so doing, the maneuver recommended for a vessel thus situated is to take the wind free on the starboard quarter and run. For doubtless sufficient reasons, however, Captain La Croix states that he placed his vessel before the wind under lower topsails and foresail. These sails, as also the forestaysail, were later carried away, and the bark fell off into the trough of the sea, described by the master as exceptionally heavy.

A vessel which narrowly escaped becoming involved in the storm at this stage of its development was the *Teodoro de*

Larrinaga (96), Liverpool to Havana. According to the weather report returned by Officer Carroll, the position at Greenwich mean noon of October 8 was latitude $32^{\circ} 44'$ north, longitude $60^{\circ} 51'$ west; barometer 29.92 inches; wind SE., force 6; sky overcast. Throughout the next 24 hours the course steered was WSW., bringing the vessel at Greenwich mean noon of October 9 to latitude $30^{\circ} 54'$ north, longitude $65^{\circ} 28'$ west. During the interval the wind backed to NNE. and increased to force 9, weather overcast and squally, with heavy rain. The report omits the lowest reading of the barometer, and it is consequently impossible to state with accuracy at what distance in advance of the center the steamer crossed the track.

As shown by the synoptic chart of that date, the position of the hurricane center at Greenwich mean noon of October 9 was in the neighborhood of latitude 30° north, longitude 61° west. Throughout the day it advanced steadily to the eastward, the depression meanwhile constantly deepening and increasing in size, and the area covered by winds of storm force extending further and further outward. At Greenwich mean noon of October 10 it had reached latitude 32° north, longitude 50° west, pressure at the center having meanwhile sunk to a point below 28.50 inches. No vessel, as far as known, came within dangerous proximity of the center of the storm in the course of its progress during these 24 hours. At the epoch represented by the chart of October 10 (fig. 2), however, the *Texan* (97), bound from Liverpool to Kingston, Jamaica, was on the immediate outskirts of the vortex. The indications recorded by the observer for the 24 hours preceding are thoroughly characteristic. The position of the vessel at Greenwich mean noon of October 9 (see fig. 1) was, as shown, in latitude $34^{\circ} 20'$ north, longitude $45^{\circ} 20'$ west, 900 miles, therefore, to the ENE. of the center of the hurricane as situated at that time.

The ship's day set in with a moderate southwesterly wind, a northerly swell, and weather exceptionally clear and fine, the sky being cloudless, save for rapidly forming long cirrus feathers passing quickly across from WNW. At 4 p. m. glass 29.59, and falling; wind freshening; sky rapidly clouding. At midnight, 29.38 and still falling; wind shifted to SSE. At 4 a. m. (of October 10), 29.28; wind blowing a whole gale, steady from SSE; sea lumpy and confused. At 8 a. m., 28.58; heavy gale. At 10 a. m., 28.53; wind falling light. At noon, glass rising; wind blowing in terrific squalls in rapid succession from the north, followed by a heavy gale; sea mountainous and confused.

The *Dania* (28), Coruna to Havana, also came within the area of rapidly shifting storm winds and felt to some extent the force of the gale. The omission of a storm log, however, renders it impossible to describe the shifts of wind and variations of atmospheric pressure. In his account of the weather experienced during the 24 hours preceding the observation of October 10, (the vessel in the course of this interval passing from latitude 35° , longitude 48° to latitude $33^{\circ} 28'$, longitude $53^{\circ} 34'$), the observer states that at 2 a. m. (of October 10) heavy rain set in and the wind increased to force 10, backing from WSW. to NNE. in seven hours, with heavy rolling sea, bad and misty weather.

In the course of October 9 a second barometric depression, attended by an independent cyclonic circulation, developed to the southeastward of Newfoundland. This depression is plainly apparent on the chart of October 10, and gave rise to severe weather along the transatlantic steamship routes during the forenoon of that day. A most interesting and complete record of its progress is contained in the storm log of the *Oxonian* (76), Galveston to Bremen; the eastward advance of this vessel, situated throughout in the northern semicircle of the depression, was but slightly exceeded by that of the depression itself, as shown by the slight variation of the barometer and by the uniform but slow shift of the wind. The position at Greenwich mean noon of October 9 was latitude $44^{\circ} 40'$ north, longitude $49^{\circ} 03'$ west; wind

south, 5; barometer 29.44 inches. Subsequent to this the wind backed to the eastward, reaching this point at 10 p. m., at which time following the storm log begins:

Date and time.	Direction and force of wind.	Barometer.	Remarks.
October 9, 10 p. m.	East, 7.	<i>Inches.</i> 29.22	
October 9, midnight	E. by N., 7.	29.18	
October 10, 2 a. m.	NE. by E., 8.	29.12	
October 10, 4 a. m.	NE. by N., 9.	29.07	
October 10, 8 a. m.	N. by E., 9.	29.03	Clouds breaking.
October 10, noon.	N. by W., 9.	29.22	Weather clearing.
October 10, midnight	North, 3.	29.44	Barometer rising fast, wind falling.
October 11, 2 a. m.	NE., 5.	29.39	Wind hauling easterly.
October 11, 4 a. m.	East, 6.	29.37	
October 11, 6 a. m.	SE., 8.	29.34	Sudden shift.
October 11, noon.	SE., 9.	29.27	
October 11, midnight	SSE., 9.	29.52	

From the above table it is apparent that the *Oxonian* was in the immediate neighborhood and to the northward of the center of the more northerly depression at 8 a. m. of October 10, and that the transition from the wind system of this minor depression to that of the greater cyclone following took place between midnight and 2 a. m. of October 11.

It is on the last-mentioned date that the latter storm developed its maximum intensity, and the fact that it was at this time about to cross the transatlantic steamship route brought many reporting vessels within its circle of influence. Several of these have furnished detailed accounts of their experience. Captain Horne of the *Indrapura* (48), New York to Gibraltar, writes as follows:

I have thought that the following account of a hurricane which this vessel has just encountered might be of some interest to you, more especially as the vessel has been involved in the center of the depression.

Our position at noon of October 10 was latitude $41^{\circ} 08'$ north, longitude $46^{\circ} 01'$ west; barometer 29.39, wind NE.; light sea, rising, from NE, taking the place of a hitherto southwesterly swell. At 4 p. m. barometer 29.31, freshening NE. breeze; rain set in. At 5:30 barometer 29.24; looking dirty; put ship with head to north and hove to solely on account of low glass in order to watch developments. At 7:30 p. m. barometer 29.18; moderate NE. gale; rising NE. sea. At 10:30 p. m. barometer 28.94; heavier rain, and gale freshening; brought wind four points on starboard quarter and engines full speed ahead; vessel making ten knots. Midnight, barometer 28.50; wind and sea increasing with great rapidity; hove ship to on the port tack, the sea being too big to run longer and fearing that we might shortly be unable to heave to at all; engines dead slow. The running of the vessel with wind on starboard quarter, combined with the more rapid fall of the glass, convinced us that we could not get across the front, especially as the wind did not shift; accordingly decided to heave to and see it out. At 2 a. m. entered the vortex; the wind fell away in a moment, but increased a few minutes later to about force 6, still NE. true, gradually falling light; the sea moderated somewhat, but confused and lumpy; the barometer continued to fall rapidly. The calm lasted for some three hours, and the barometer fell at last to 27.94 inches, this being the lowest reading. It then rose 0.10 of an inch, and the wind came out like a shot from NW. true. The wind thus shifted eight points, from which it would seem that we were not in the direct line of progression after all, as in this case it would have shifted sixteen points.

In a moment it was blowing a whole hurricane. The sea consisted of huge masses of water (about 35 feet). They were not waves and did not look like them; just huge pointed masses of water, like a boiling pot on a very large scale, coming from all sides, but chiefly from NNE. and WNW. The worst of this was past in some twenty minutes and then the high irregular sea set in. The spouddrift made it impossible to see more than a few yards and there seemed to be a good deal of rain, but there was so much spray flying that it was difficult to say. The hurricane blew with unabated violence for some seven hours, or until the glass had risen to 29.00. By this time the wind had drawn around to SW. and it gradually cleared.

Captain Horne then draws the following conclusions, which are of value as tending to dissipate the belief in hot, moist weather, lurid sunrise and sunset, increasing ocean swell, etc., as necessary and sufficient indications of the approach of these disturbances.

1. Persistent northeast wind and sea gradually increasing, but showing no serious symptoms until within six hours of entering the vortex.

2. There had been a slightly confused sea 48 hours before the hurricane, but this had subsided, and there was none in the 24 hours immediately preceding it.

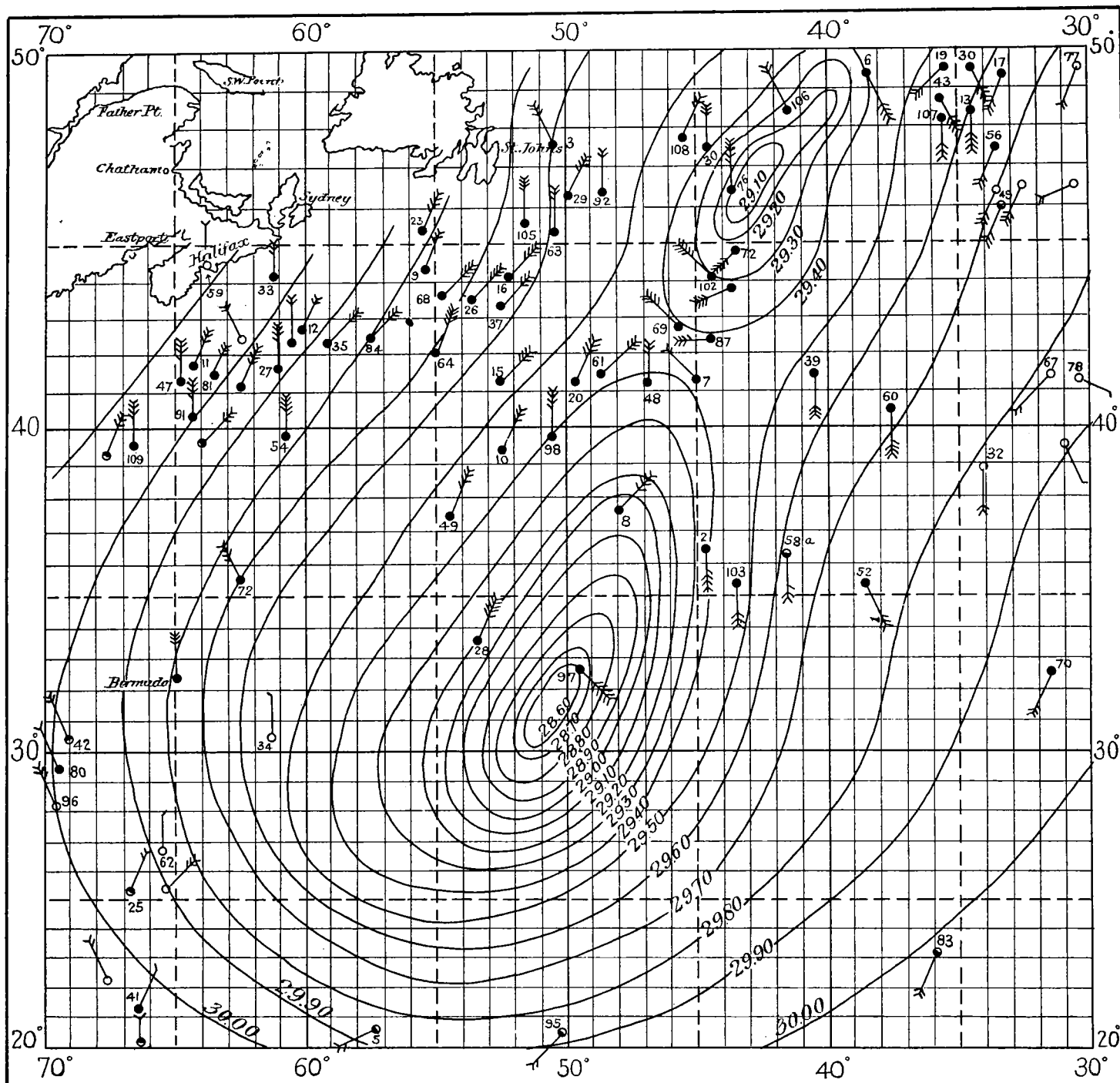


FIG. 2.—Synoptic weather chart, Greenwich mean noon, October 10, 1905.

3. The clouds presented nothing out of the common, and there was no scud. There was no oppressive heat at any time, the temperature being lower during the gale than either before or after.

4. The rainfall was not remarkable; though copious, it in no way resembled a tropical downpour.

5. Until the center had passed, the horizon was fairly clear.

6. There were no vivid tints at the preceding sunset or sunrise.

7. With the exception of the barometer, there was nothing alarming in the weather symptoms until within three hours of the vessel's entering the center.

8. Scudding to the west after the glass had fallen so low possibly made matters worse; if done at all, it should be done early.

9. The storm center was completely clouded over. There was no eye of the storm.

10. The true hurricane came only after the center had passed, and the glass had commenced to rise.

11. The wind was of such violence that after the gale large pieces of gulf weed were found at the top of the masts (100 feet) where the wind and spray had carried them.

12. For a steamer hove to, without yards and sails, there is no danger of being taken aback, and it is almost impossible for her to get stern way. For a sailing vessel the danger is very great, and she would possibly founder in the boiling water immediately on the outskirts of the hurricane.

13. This vessel was hove to, and over 130 gallons of heavy engine oil was used from water closets and small oil bags, the idea being to surround the vessel with a large oil bath. She shipped no water and, with the exception of the blowing away of dodgers and drowning of sea stock, sustained no damage, as far as can be at present ascertained.

From the above report it is evident that the center of the hurricane passed to the eastward of the *Indrapura* (48). The *Mohawk* (69), Galveston to Havre, eastward bound in slightly higher latitude than the former vessel, and for this reason enabled to hold her course a few hours longer, succeeded in crossing the front, and rode out the storm in the eastern semicircle. Her position at Greenwich mean noon of October

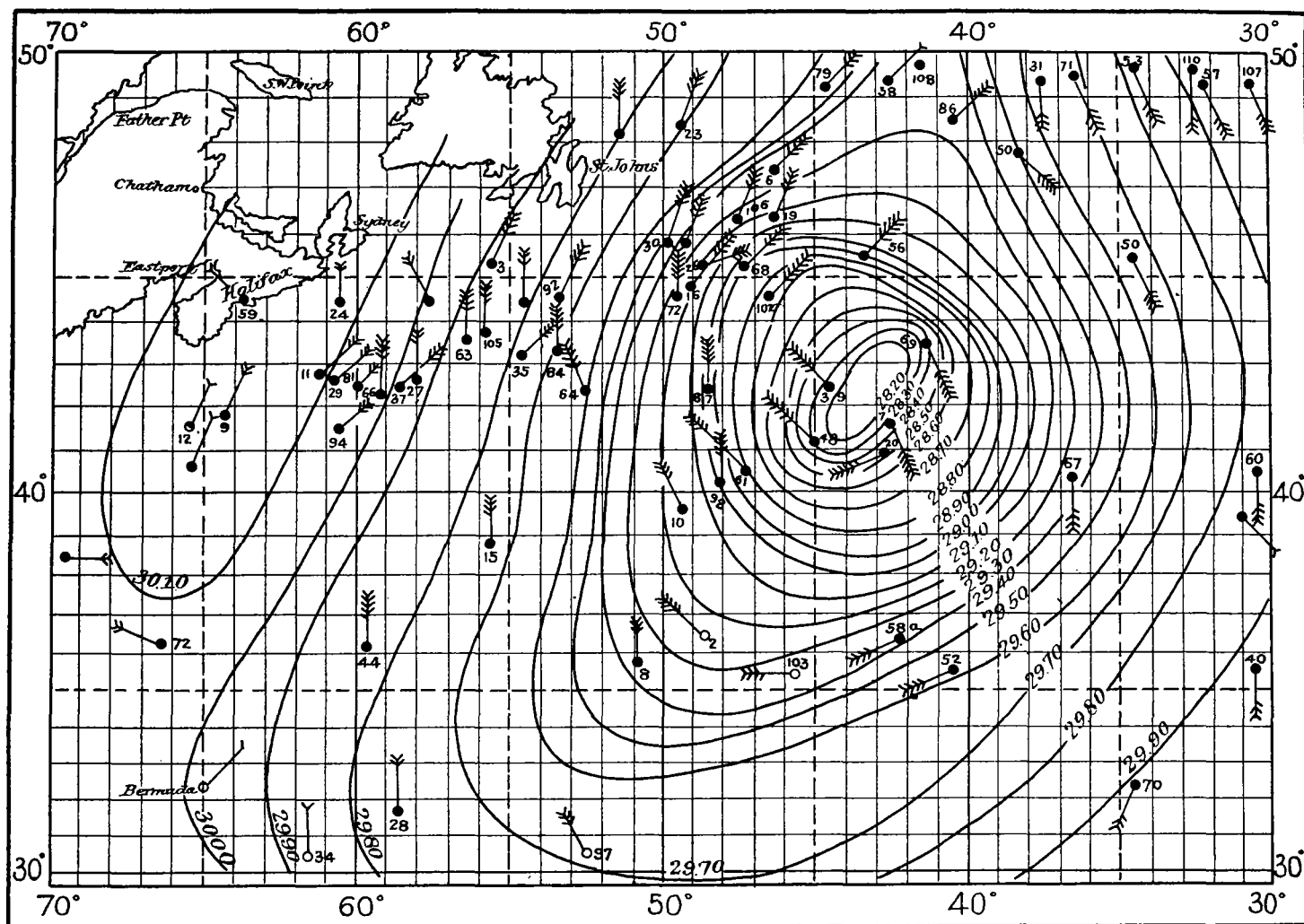


FIG. 3.—Synoptic weather chart, Greenwich mean noon, October 11, 1905.

10, was: latitude $42^{\circ} 33'$ north, longitude $45^{\circ} 56'$ west; wind NW., 7; barometer 29.48 inches, rising: all tending to show that the vessel was still within the circle of the minor depression now rapidly retreating northward.

At local noon, however, the conditions had changed. The barometer, although higher (29.54 inches) than at 9 a. m., was now falling: a fresh northerly gale prevailed, with sea confused, but a heavy swell from SW. predominant. At midnight, fresh NE. gale, with fierce squalls from ENE. At 4 a. m. (October 11) barometer 28.75; wind, E., strong gale, with terrific squalls from SE. At 8 a. m., latitude $43^{\circ} 30'$ north, longitude $41^{\circ} 50'$ west; barometer 28.24 inches, this being the mean reading, as the instrument at the time was pumping violently.

At this time the hurricane struck the ship from SE., quickly raising a confused, mountainous sea; atmosphere thick with spindrift, and unable to see further than 100 yards in any direction. With rapidly rising sea and terrific squalls, the vessel became unmanageable, being unable to heave to or run, so stopped the engines and used engine and lineal oil from three waste pipes with good results; the vessel drifting over three knots, leaving a wake to windward over which the oil spread rapidly, causing seas to curl and break before reaching the vessel.

At 10 a. m. the true sea started to make from the south with the wind in that direction, and although tremendous, was not so confused as at 8 a. m. For 21 hours the ship lay in the trough of the sea, riding the seas admirably, and taking but little water of any great weight. Wind at 8 a. m., SSE.; at noon, S.; at 6 p. m., SSW.; at midnight, SW., remaining in the latter quadrant until 6 a. m., October 12. During this gale there was but little rain, a few lightning flashes, and no thunder.

A fact of value, brought out in Captain White's report, as given above, is that the squalls invariably came from the point toward which the gale was about to shift; thus the northeast gale was interrupted by squalls from ENE., the easterly gale by squalls from SE., etc.

Another interesting report is that returned by the *Germania*

(39), Marseilles to New York, the vessel apparently having crossed the path of the storm immediately in advance of the center. Her position at Greenwich mean noon of October 10 (see fig. 2) was latitude $41^{\circ} 47'$ north, longitude $40^{\circ} 28'$ west; strong breeze from the south, with heavy sea. As vessel and storm center neared each other the wind went first to NE. and thence to SE., blowing from the latter direction in violent squalls. During the evening watch the breeze freshened and the glass fell rapidly. At 2 a. m. the hurricane burst upon the vessel with terrific force from NE., sea high from all directions, but enormous from NW. At 8 a. m. barometer 28.11 inches (714 mm.), the wind hauled to NW. At 9 a. m. the barometer rose to 28.23 inches (717 mm.), thick mist, fine rain, and wind still blowing with hurricane force.

During this foul weather the wind shifted in a direction contrary to the motion of the hands of a watch; the heaviest sea came from a northerly direction, varying from NNE. to NNW.; the gale attained its maximum force between 5 and 6 a. m.; the lowest point reached by the barometer was 28.11 inches (714 mm.). The sky was covered throughout, with fine rain and mist.

The record of the self-recording aneroid aboard the *Germania* is given in fig. 5. The record of the similar instrument aboard the *La Savoie* (56) is also shown (see fig. 6). Greenwich time is employed in both instances. The latter vessel, westward bound like the former, also succeeded in crossing the path of the storm in advance of the center. The record for the 24 hours following Greenwich mean noon of October 10 is interesting, as showing the transition of the vessel from the rear semicircle of the preceding cyclonic area shown upon

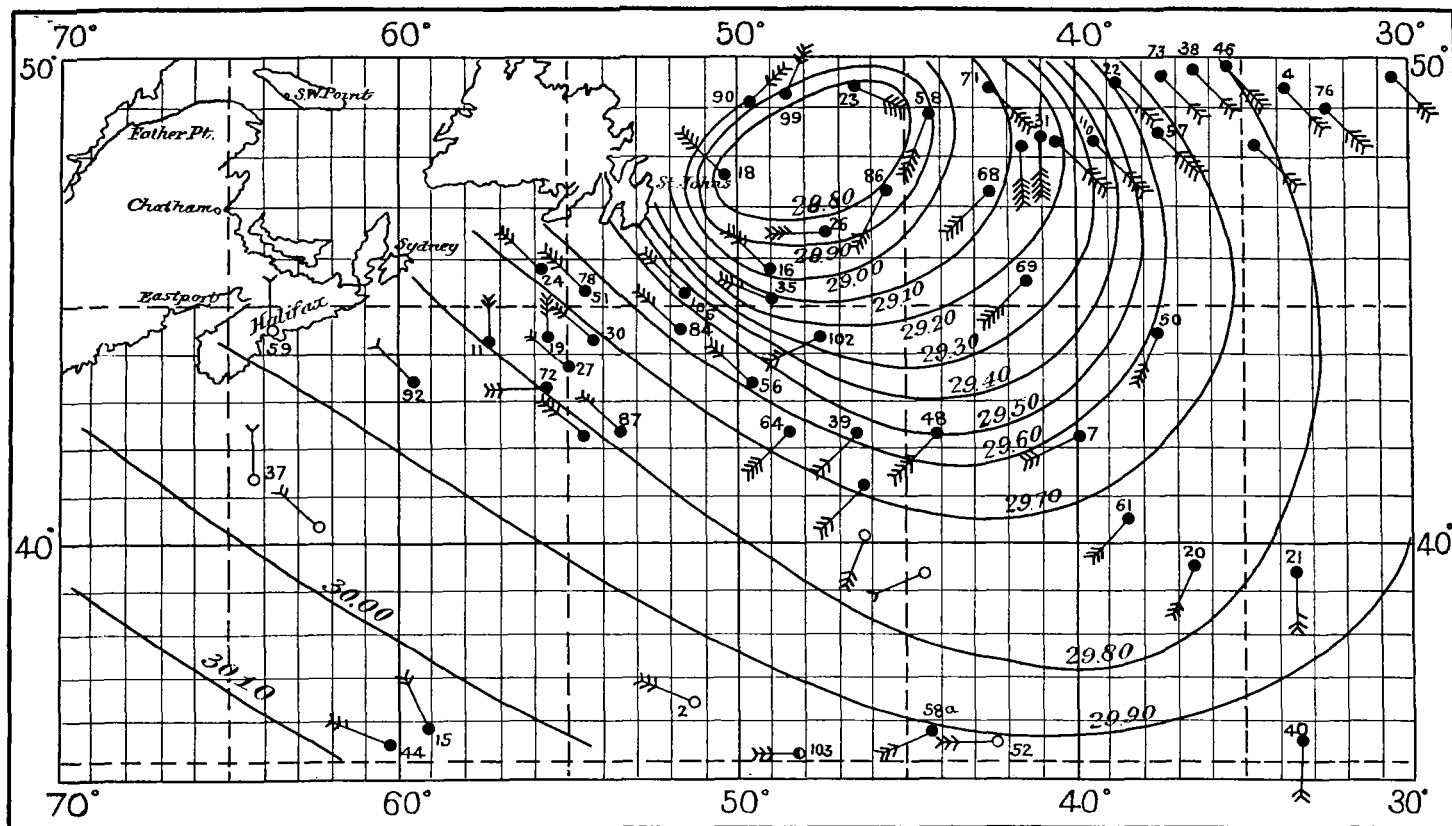


FIG. 4.—Synoptic weather chart, Greenwich mean noon, October 12, 1905.

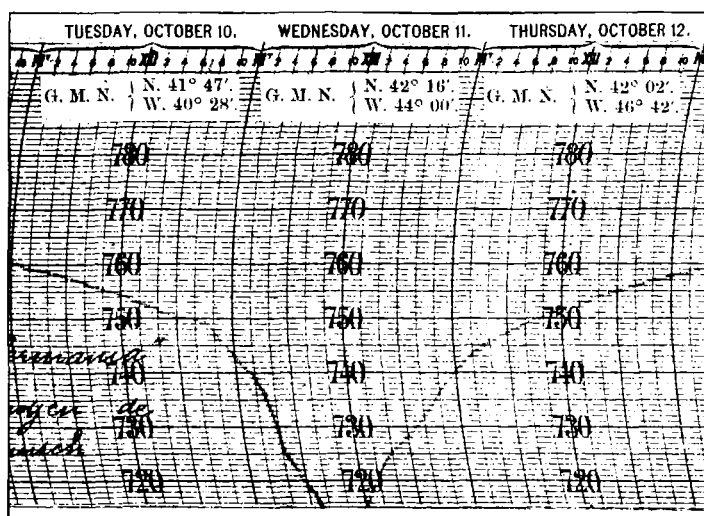


FIG. 5.—Barogram from aneroid on S. S. Germania.

the chart of that date (fig. 2) to the forward semicircle of the following area. The position at Greenwich mean noon was, as shown on fig. 2, in latitude $47^{\circ} 56'$ north, longitude $33^{\circ} 19'$ west, wind SSW., 5; overcast sky, with squalls. As the vessel advanced westward into the rear of the first depression, the wind went to SSE. and later to SSW. About midnight, coincident with the passage from the wind system of the first or northern depression into that of the southern, the winds became variable and the diminution of pressure for the time being practically ceased, as shown by the self-recording aneroid. Once within the greater cyclonic area, however, the barometer again fell; the wind, which had settled at NW., went successively to NNE., NE., and ENE., constantly increasing in violence; the sea became very high and the pressure

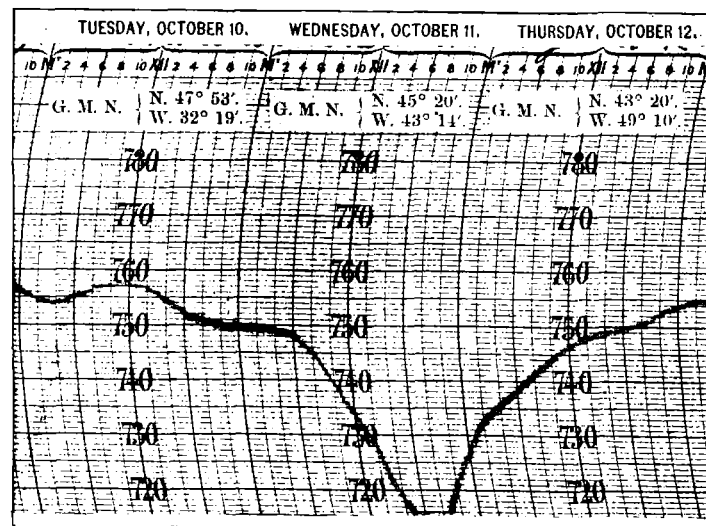


FIG. 6.—Barogram from aneroid on S. S. La Savoie.

diminished rapidly. At Greenwich mean noon of October 11 the pressure was 28.82 inches (732 mm.); at local noon it had reached 28.31 inches (719 mm.), and at 3 p. m., 28.03 inches (712 mm.), the descent ceasing at this point. The position of the *La Savoie* at this time was latitude $45^{\circ} 00'$ north, longitude $45^{\circ} 00'$ west, and the shifts of the wind were successively NNE., NNW., NW., NNW., showing that the vessel was to the westward of the path pursued by the cyclonic center. The barometer meanwhile rose rapidly.

In each of the barographs shown, the depth of the depression exceeded the limit of the sheet.

The report of the *Campania* (19), Liverpool to New York, is worthy of note, this steamship having suffered damage by contact with the storm, attended by loss of life. The vessel crossed

No.	Vessel.	Captain.	Reported by—
1	Albano, Ger. S. S.	Kudenhold	II Officer Luhrs.
2	Algeria, Br. S. S.	Wards	Officer Booth
3	Almora, Br. S. S.	Turner	Officer McGavin.
4	Amstedijk, Du. S. S.	Baron	Officer de Kup.
5	Annie M. Parker, Br. Schr.	Carter	Master.
6	Arabic, Br. S. S.	Atkin, R. N. R.	I Officer.
7	Asama, Br. S. S.	Carr	Officer Myles.
8	Atlanten, Sw. S. S.	Svenson	Master.
9	Baltic, Br. S. S.	Smith	Officer Simpson.
10	Bayonne, Ger. S. S.	von Hugo	Officer Frankenbusch
11	Belfast, Br. S. S.	McKee	III Officer Noble.
12	Black Prince, Br. S. S.	Sheppard	III Officer Jackson.
13	Bluecher, Ger. S. S.	Reessing	IV Officer Bauer.
14	British Empire, Br. S. S.	Riddle	Officer Bender.
15	British Trader, Br. S. S.	Hutchinson	Officer Williams.
16	Brooklyn City, Br. S. S.	Bailey, R. N. R.	Officer Stoton.
17	Bovic, Br. S. S.	Kerr	Officer Harbord.
18	Caledonian, Br. S. S.	Baxter	III Officer.
19	Campania, Br. S. S.	Ware	Officers Horsburgh & Porley.
20	Canopic, Br. S. S.	Bartlett, R. N. R.	Officer Thomas.
21	Cayo Manzanillo, Br. S. S.	Winter	Master.
22	Cestrian, Br. S. S.	Thomas	Officer Harker.
23	Columbia, Br. S. S.	Wadsworth	Officer Paulsen.
24	Contre Amiral Caubet, Fr. S. S.	Degrad	Officer Gallocher.
25	Corfe Castle, Br. S. S.	Nutman	Officer Blanchard.
26	Cornishman, Br. S. S.	Thornton	Officer Wormald.
27	Crown Point, Br. S. S.	Wall	II Officer.
28	Dania, Ger. S. S.	Bonath	Officer Nachtwey.
29	Deutschland, Ger. S. S.	Kaempff	Officer Vincker.
30	Elise Marie, Ger. S. S.	Steg	Officer Sievers.
31	Elswick Hall, Br. S. S.	Cripsey	Officer Berg.
32	Emilia, Port. Bk.	Domingues	Officer Cochot.
33	Excelsior, Ger. S. S.	Courtin	Officer Meyer.
34	France Marie, Fr. Bk.	La Croix	Master.
35	Friesland, Bel. S. S.	Rogers	Officer Alford.
36	Furnessia, Br. S. S.	Blakie	Master.
37	Gallia, Fr. S. S.	Bouleue	II Officer.
38	Georgie, Br. S. S.	Clarke	Officer Browne.
39	Germania, Fr. S. S.	Jaubert	Officer Latil.
40	Gibraltar, Br. S. S.	Knagg	Officer Pegden.
41	Glooscap, Br. Sp.	Spicer	Master.
42	Grenada, Br. S. S.	Murchison	Master.
43	Grosser Kurfurst, Ger. S. S.	Mentz	Officer Siebert.
44	Hainaut, Du. Sp.	Jacobs	Officer Schwede.
45	Horta, Azores.		
46	Iberian, Br. S. S.	Jago	Officer Harris.
47	Indore, Br. S. S.	Mytton	Officer Stancliffe.
48	Indrapura, Br. S. S.	Horne	Officer Barston.
49	Iowa, Br. S. S.	Walters	Officer Jackson.
50	Iris, Bel. S. S.	Sytor	Officer Achtergaal.
51	Kaiser Wilhelm II, Ger. S. S.	Hogemann	Officer Mahbmaun.
52	Knight of St. George, Br. S. S.	Stephens	Officer Hogan.
53	Kolu, Ger. S. S.	Konemann	Officer Werther.
54	Konigin Luise, Ger. S. S.	Volger	Officer Elser.
55	La Lorraine, Fr. S. S.	Alix	Officer Guerin.
56	La Savoie, Fr. S. S.	Poirot	Officer Sous.
57	Le Coq, Br. S. S.	Peterson	II Officer.
58	Lucifer, Br. S. S.	Prowse	Officer Colvin.
59	Lustleigh, Br. S. S.	Boottman	Officer Cuthford.
60	Mackay-Bennett, Br. S. S.	Schenk	Officer Richardson.
61	Madonna, Br. S. S.	Lauder	Officer McKay.
62	Manuel Calvo, Sp. S. S.	Castella	Officer Morales.
63	Maranhense, Br. S. S.	Casey	Officer Arrowsmith.
64	Martello, Br. S. S.	Schekell.	Officer Massam.
65	Matteawan, Br. S. S.	Bennett.	Master.
66	Mesaba, Br. S. S.	Tubb	Officer Beresford.
67	Mexican, Br. S. S.	Slater	Officer Chirwin.
68	Michigan, Br. S. S.	Stapleton	Officer d'Anquier.
69	Minnehaha, Br. S. S.	Robinson	Officer Lewin.
70	Mohawk, Br. S. S.	White	III Officer.
71	Mokta, Br. S. S.	Cooper	Officer Lawson.
72	Mount Temple, Br. S. S.	Forster	Officer O'Reilly.
73	Napoli Prince, Br. S. S.	Eagleton, R. N. R.	Officer Campbell.
74	Noordam, Du. S. S.	Bonjer	Officer Pann.
75	Obi, Br. S. S.	Evans	Officer Jones.
76	Oldenburg, Ger. S. S.	Troitzich	III Officer.
77	Oxonian, Br. S. S.	Dickinson	Officer Lawson.
78	Pectan, Br. S. S.	Daniel	Officer Yeomans.
79	Perugia, Br. S. S.	Johnston	Officer Bewsher.
80	Philadelphia, Am. S. S.	Mills	Officer Dorry.
81	Ponce, Am. S. S.	Dalton	Officer Mundy.
82	Potomac, Br. S. S.	McKay	Officer MacDonald.
83	Primo, It. Bk.	Gibelli	Master.
84	Quevilly, Fr. Bk.	Ladonne	Officer Carpentier.
85	Rappahannock, Br. S. S.	Buckingham	Officer Allan.
86	Rhein, Ger. S. S.	Rott	Officer Reher.
87	Sachem, Br. S. S.	Murdoch	Officer Lowe.
88	Saint Hugo, Br. S. S.	Stabb	Officer Hudson.
89	Santa Cruz, Azores.		
90	Siberian, Br. S. S.	Eastaway	Officer Paterson.
91	Sicilia, It. S. S.	Sartorio	Officers.
92	Standard, Ger. S. S.	Sluiter	Officer Schulte.
93	Sylvania, Br. S. S.	Cresser	Officer Hughes.
94	Templemore, Br. S. S.	Henry	Officer Candlish.
95	Tennyson, Br. S. S.	Ohls	Officer Alexander.
96	Teodoro de Larrinaga, Br. S. S.	Hudson	Officer Carroll.
97	Texan, Br. S. S.	Land	Officer Martin.
98	Traveller, Br. S. S.	Donald	Officer Turgoose.
99	Trebia, Br. S. S.	Hilton	Master.
100	Tuscarora, Br. S. S.	Hollingshead	III Officer.
101	Vera, Br. S. S.	Dunstan	Officer Olsen.
102	Virginia, Br. S. S.	Reid	Officer Lane.
103	Virginia, Ger. S. S.	Rauschenplat	Master.
104	Wells City, Br. S. S.	Carey	Officer Brooks.
105	Welshman, Br. S. S.	Kay	Officer Popham.
106	West Point, Br. S. S.	Robertson	Officer Lloyd.
107	Willkommen, Ger. S. S.	Lotze	Officer Hollander.
108	Yarborough, Br. S. S.	Turner	Officer Gunn.
109	Zeeland, Br. S. S.	Broomhead	Officer Müller.

the rear of the preceding depression during the afternoon and night of October 10, entering the system of winds surrounding the succeeding depression at 4 a. m. of October 11. At this hour the wind, hitherto moderate from NW., freshened from NE., with overcast sky and falling glass; at 8 a. m. a strong NNE. gale prevailed, with rough sea; at 4 p. m. a whole gale set in, blowing with violent squalls, and accompanied by a high and dangerous sea. Similar weather and conditions prevailed until 2:45 a. m. of October 12, at which hour the wind backed to north, gradually declining in force until 8 a. m., when it sank to a moderate gale (see fig. 4).

Subsequent to midnight of October 12, the storm seems to have diminished materially in energy, although no reports have been received from vessels in the immediate vicinity of the center on that date. Several, however, among them the *Caledonian* (18), the *Columbia* (23), and the *Arabic* (6), crossed the track at no great distance from the center without experiencing especially severe winds.

The reports furnished by the vessels and island stations named in the list preceding have been utilized in the preparation of the present account of the storm. The numbers attached to the observations shown on the daily synoptic charts (figs. 1, 2, 3, 4) agree with those given in the preceding list.

IMPROVED METHODS FOR FINDING ALTITUDE AND AZIMUTH, GEOGRAPHICAL POSITION, AND THE VARIATION OF THE COMPASS—SECOND ARTICLE.¹

By "X."

The widespread movement to abolish calculation in determining a ship's place at sea from observations of the altitude of celestial bodies is making progress. It is necessary also to provide methods which, by being rid of restrictions as to the situation of the observed body in the firmament that were involved in the old routine of calculating morning and evening spherical triangles, are capable of meeting the need for such frequent determinations of both geographical position and true bearing as are now requisite in consequence of the increased speed of ships. As a further evidence of progress in these efforts, attention must be called to the tables of Victor Fuss, who until his recent retirement was director of the Imperial Naval Observatory at Kronstadt, and also to the abacus, or diagram, constructed by MM. Favé and Rollet de l'Isle, hydrographic engineers in the naval service of France.

In remarking upon the principles of some tables that he had computed for the purpose of relieving the tedium of numerical and logarithmic computation in finding the Sumner line at sea, Sir William Thomson, now Lord Kelvin, long ago said:²

When we consider the thousands of triangles daily calculated on all the ships at sea, we might be led for a moment to imagine that everyone has already been solved, and that each new calculation is merely a repetition of one already made; but this would be a prodigious error, for nothing short of accuracy to the nearest minute in the use of data would thoroughly suffice for practical purposes. Now, there are 5400 minutes in 90°, and therefore there are 5400², or 157,464,000,000 triangles, to be solved for a single angle. This, at 1000 fresh triangles per day, would occupy above 400,000 years. Even with an artifice such as that to be described below, for utilizing solutions of triangles whose sides are integral numbers of degrees, the number to be solved (being 90³, or 729,000) would be too great, and the tabulation of the solutions would be too complicated. * * *

A recent article in the MONTHLY WEATHER REVIEW, entitled "Improved methods for finding altitude and azimuth, geographical position, and the variation of the compass," takes occasion to point out that Mr. Littlehales, hydrographic engineer of the U. S. Hydrographic Office, has constructed and is now about to publish graphical tables in which the solutions of the spherical triangle for values varying from minute to

¹ The first article on this subject by "X" will be found in the Monthly Weather Review for June, 1905.

² Proceedings of the Royal Society (of London), Vol. XIX, 1870-1871, p. 260.